

WHAT IS CLAIMED IS:

1. An internal combustion engine ignition apparatus, comprising:

an ignition coil having a primary coil and a secondary coil;  
and

a switching circuit which interrupts a current of the primary coil of the ignition coil on the basis of an ignition signal voltage to generate a high voltage for ignition in the secondary coil of the ignition coil, wherein

the ignition signal voltage is a pulse-like voltage including a rising portion and a falling portion,

the switching circuit has no power supply terminal connected to a battery and includes an output terminal connected to the primary coil of the ignition coil, an input terminal for receiving the ignition signal voltage, and a reference potential terminal,

the switching circuit includes a switching element which is connected between the output terminal and the reference potential terminal, applies a current to the primary coil of the ignition coil in an on state, and interrupts the current of the primary coil when an off state is caused, a drive resistor for the switching element, and a current supply circuit which is connected between the input terminal and the reference potential terminal and supplies a driving current

to the drive resistor,  
on the basis of the ignition signal voltage, the current supply circuit starts to supply the driving current at the rising portion and brings the switching element into the on state, and the current supply circuit interrupts the driving current at the falling portion thereof to bring the switching element into the off state,  
the current supply circuit includes a constant current circuit, and  
the constant current circuit causes the driving current to become a constant current, and supplies the driving current, which is made the constant current, to the drive resistor.

2. An internal combustion engine ignition apparatus according to claim 1, wherein the switching circuit includes an ignition signal line connected to the input terminal, and a reference potential line connected to the reference potential terminal, the current supply circuit is connected between the ignition signal line and the reference potential line, and the constant current circuit is connected between the ignition signal line and the reference potential line.

3. An internal combustion engine ignition apparatus according to claim 2, wherein the current supply circuit includes an output transistor for supplying the driving current to the drive resistor, the constant current circuit includes a constant current transistor for generating the

constant current, and the constant current transistor outputs a constant-current to the output transistor.

4. An internal combustion engine ignition apparatus according to claim 2, wherein the switching circuit includes a current limiting circuit for limiting a flowing current of the switching element.

5. An internal combustion engine ignition apparatus according to claim 4, wherein the current limiting circuit includes a flowing current detection circuit for detecting the flowing current of the switching element, the driving current from the current supply circuit to the drive resistor is reduced depending on an increase of the flowing current, and the flowing current of the switching element is reduced.

6. An internal combustion engine ignition apparatus according to claim 5, wherein the switching element is an IGBT, the switching element includes an emitter and an auxiliary emitter, and the flowing current detection circuit is connected to the auxiliary emitter.

7. An internal combustion engine ignition apparatus according to claim 5, wherein the switching element is an IGBT including a sense IGBT, and the flowing current detection circuit is connected to the sense IGBT.

8. An internal combustion engine ignition apparatus according to claim 4, wherein the current limiting circuit includes an output voltage detection circuit for detecting

an output voltage at the output terminal, and changes a current limiting characteristic for the switching element depending on the detected voltage of the output voltage detection circuit.

9. An internal combustion engine ignition apparatus according to claim 8, wherein the output voltage detection circuit includes a voltage changing unit for changing the detected voltage stepwise as the output voltage is increased, and the current limiting characteristic for the switching element is changed stepwise.

10. An internal combustion engine ignition apparatus according to claim 9, wherein a bent point is provided in the current limiting characteristic, and in a region of the output voltage at a side lower than the bent point, as compared with a region of the output voltage higher than the bent point, an inclination of the flowing current of the switching element with respect to the output voltage is made small.

11. An internal combustion engine ignition apparatus according to claim 9, wherein the switching element is an IGBT, and the output detection circuit is connected to a latch-up transistor constructed in the IGBT.

12. An internal combustion engine ignition apparatus according to claim 2, wherein the switching circuit includes an output voltage detection circuit for detecting an output voltage at the output terminal, and when the output voltage

is increased, a flowing current of the switching element is reduced or interrupted.

13. An internal combustion engine ignition apparatus according to claim 2, wherein the switching circuit includes an over-energization protection circuit, and when an energization time of the switching element becomes longer than a specified time or longer, the over-energization protection circuit turns off the switching element.

14. An internal combustion engine ignition apparatus according to claim 2, wherein the switching circuit includes a current limiting circuit for limiting a flowing current of the switching element, a output voltage detection circuit for detecting a voltage at the output terminal and reducing the current of the switching element when the voltage at the output terminal is increased, and an over-energization protection circuit for turning off the switching element when an energization time of the switching element becomes a specified time or longer.

15. An internal combustion engine ignition apparatus according to claim 14, wherein the current limiting circuit, the output voltage detection circuit, and the over-energization protection circuit, together with the current supply circuit, are integrated on a common semiconductor substrate.